Practical Approach to Buildings' Energy Performance Enhancement

AN EESL PERSPECTIVE

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EESL Profile

- Energy Efficiency Services Ltd. established as a JV of NTPC, REC, PGCIL and PFC in December 2009, registered under companies act 1956

It is the first such government company exclusively for implementation of energy efficiency in South Asia and amongst very few such instances in the world

NTPC

POWER GRID

PFC

Energy Efficiency Projects for Demand Side Measures

- Agriculture

FD, technology, etc.

State Gov. policies

cheme for industries

Consultancy Services

- General Consultancy across sectors
- Policy advice to the government
- CSR and SD projects for PSUs

Development of Private ESCOs

Building Conservation Strategies

The Options!!...

- **Option1: Deferred Capital Cost Recovery**
- **Option 2: DSM based utility rebate**
- **Option 3: Performance Contracting through ESCO Model**

Using innovative financial mechanisms to realise energy efficiency projects

- The industry could avoid investments and yet have more profit

1. Deferred Capital Cost Recovery

- Energy audit conducted to determine the investments and savings
- Replacement of equipments with BEE 5 STAR rated ones (wherever available). Lighting replacement with LEDs
- Building Management System to monitor the energy consumption on real time basis – installation of sub-meters for monitoring of consumption and tighter control of system operational parameters to exploit additional savings to secure energy efficiency investments in long term
- Deferred Payment to EESL over 2 years
- Annual monitoring and verification by BEE
- **Niti Aayog and Shram Shakti Bhawan – completed!**
- **Challenge** – requires budget provision with the ministry to pay for the equipments – **replication limited**

2. DSM Based Utility Rebates Program

- Rebate allowed by Regulatory Commission for purchase of BEE 5 STAR rated equipments for Public Buildings (ex. - Maharashtra and Gujarat)
- Examples are Tata Power Delhi/Mumbai – EE appliances
- MSEDCL Program – Rebate for Fans, ACs, Chillers, efficient lighting to the extent of 25% of capital cost
- Health, schools and other public buildings included as the target
- Building owners to arrange for balance 75% **(for which EESL is willing)**
- Annual monitoring and verification by 3rd party independent agency
- **Challenge- requires budget provision with the ministry to pay for the equipments – replication limited**

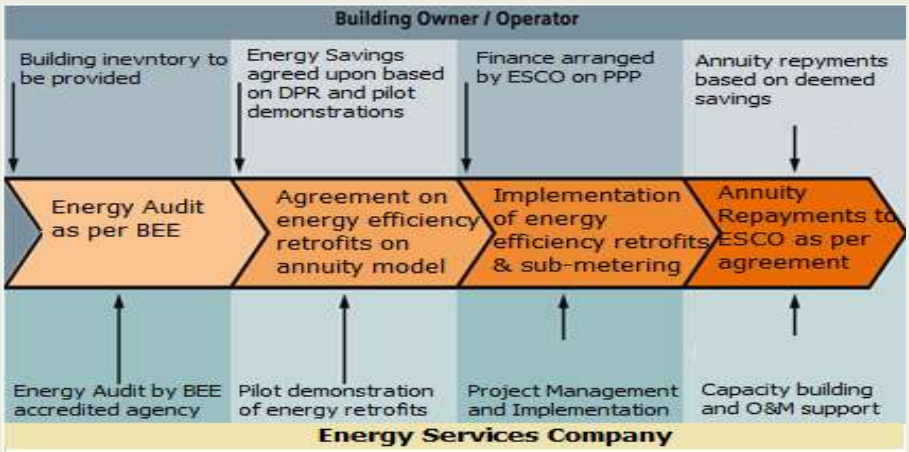
3. ESCO Based Implementation

- Entire Capital Cost arranged by ESCO – no budget provision required
- Technical and financial risk borne by ESCO subject to payment security
- Payments based on performance – with adequate balancing of risks by using deemed savings model
- No direct linkage with electricity bill reduction
- Incentives for ESCOs for performing better than expectations
- Annual monitoring and verification by 3rd party independent agency
- **Challenge – advisory from Ministry of Finance necessary for CPWD/Ministries to pay the reduction in electricity bills to ESCO**
- **High Replication Potential**

Wish-list for ESCO

- **Advisory/ Guidance to enable payment to ESCOs – from MOF/MoUD**
- **Single Ministry Buildings** – Direct authorization to CPWD to make ESCO repayments to ESCO from the electricity budgets
- **Multi-Ministry Buildings** – Whole building by CPWD itself or individual Ministry may be authorized to undertake ESCO using separate head of accounts under office expenses (non-plan) to make ESCO repayment
- **Benchmarks for buildings** – Installation of energy management system
- Approval of **standard performance contract** that can be used by all Ministries
- **Annual monitoring and verification** by BEE or accredited 3rd party independent agency

ESCO Perspective



Some Projects

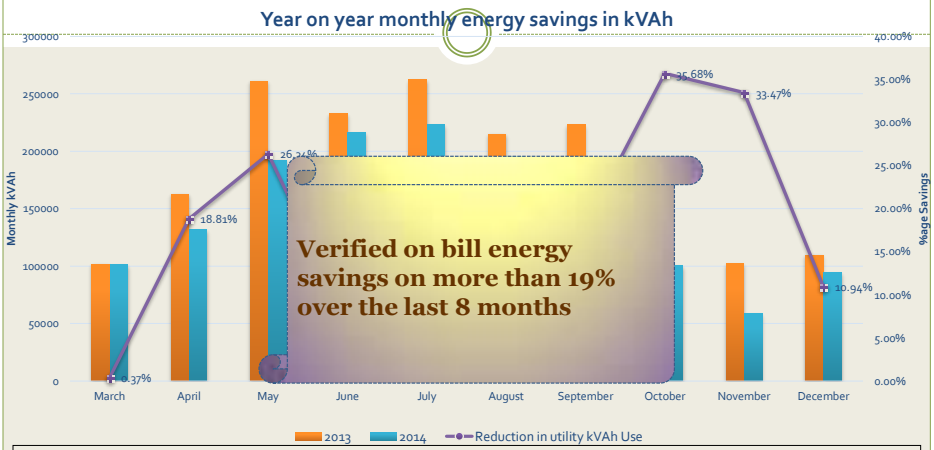
Yojana Bhawan	• Project initiated by BEE to enable Yojana Bhawan get BEE 5 star rating • Project Completed by EESL on Deferred capital recovery model • 20% on bill energy savings achieved
Shram Shakti Bhawan	• Energy Efficiency retrofits for all 3 Ministries – Power, Labour and Water • Project Investment – Rs. 120 Lacs, Energy Cost Savings Rs. 40 lacs
Bengal Chambers Kolkata	• First ESCO project agreement signed by EESL • Essentially a 7 year contract wherein EESL is obligated to provide energy efficient LED and fans as also undertake maintenance related issues • Project entered into PMV period w.e.f. 03.09.2014
Public Health Department, Govt. of Maharashtra	• PHD, Govt. of Maharashtra has signed EESL as technical consultant • Agreement for detailed study at 5 district hospitals completed • Negotiation for signing ESCO agreement for further implementation underway
India Habitat Centre	• State of art complex - latest HVAC controls technology & building envelope • 4000 LED for all lighting functions to reduce annual kWh by2 Lac units • EESL working as transaction advisor to their Managing Committee
PSU Buildings	• Successfully completed audits for MMTC, REC, CONCOR Tuglakhabad • More projects on anvil – Pawan Hans Ltd., CONCOR Dadri, etc.

Niti Aayog (Yojana Bhawan)

Yojana Bhawan	Shram Shakti Bhawan
Total annual electricity consumption before retrofit 29 Lacs kWh **-Total annual electricity bill before retrofit Rs. 170 Lacs** -Main equipment replaced 591 nos. of old fans with B 2176 lighting points with L 37 ACs retrofits (all 1.5 TR 328 nos. of micro-processo 1 no. of 15 HP water pump efficient 12.5 HP pump Energy Management Syste operational controls and e nce savings **-Total capital cost Rs. 85 Lacs (EMS excluded)** **-Annual electricity consumption after retrofit 21.5 Lac KWh** - Annual Energy Savings – 7.7 Lacs KWh **- Annual electricity cost savings – Rs. 54 Lacs** - Approx. Simple payback 1.7 years	**- Total energy consumption before retrofit 40 Lacs electricity units** **- Annual electricity bill for SSB – Rs. 360 Lacs** - Main equipment re ced BEE 5 star fans d lights (all 1.5 TR) with BEE 5 star 1.5 TR) with BEE 5 star ng system being laid out for ol **-Total capital cost Rs. 120 Lacs** **- Annual electricity consumption after retrofit 35.6 Lac Units** - Annual Energy Savings – 4.4 Lac KWh **- Annual electricity cost savings – Rs. 40 Lacs** - Approx. Simple payback 3 years

All procurements done through competitive bidding..

On Bill Energy Savings…



Verified on bill energy savings on more than 19% over the last 8 months

A snapshot of the year on year monthly energy savings. For the month of April 2014, savings are relatively less as compared to April 2013 as the project was in its nascent stages. As the implementation picked up pace in April, the May bill from NDMC reported 18% savings. Implementation was completed by May 2014 and subsequent bill for June 2014 reported 26.4% savings. **Till date average monthly savings of 19% reported on actual bill.**

Site Pictures


- Average illumination levels with old lights 158.25 lux
- Average illumination levels with LED improved to 348.25 lux
- Average increase in illumination levels across the building – 120%
- Average Lighting power density reduced from 15 W/ sq. ft to 7 W/sq. ft
- Overall annual energy savings in the lighting domain more than 2 Lac energy units
- Uniform illumination across the premises


- Old split and window ACs replaced with BEE 5 star split and window AC respectively
- Average energy savings of 17.9%
- Better cooling leading to reduced run time
- Better cooling comfort and end user experience
- Built in energy savings mode
- Savings complimented through use of AC energy saver
- Annual energy savings equivalent to nearly 3 Lac energy units


- Old pump of 15 hp replaced with energy efficient 12.5 hp with better head and flow capacity
- Absolute power reduction of 3 kW
- Smaller sized pump – easy retrofit solution
- Average flow enhanced from 315 cmh to 350 cmh for the same pressure level
- Reduction in overall pump use time and better life
- Annual energy savings equivalent to more than 10000 energy units

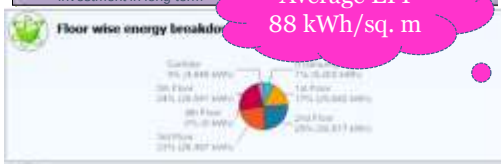
Energy Management System

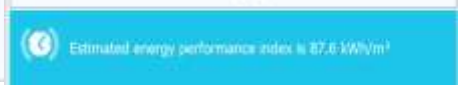
BENEFITS OF THE EMIS SYSTEM INSTALLED AT YOJANA BHAWAN

- Remote data analytics from anywhere across the globe
- Enables setting up baseline and KPIs at different levels within the organization
- Enables setting up measurable targets and tracking of same in real time
- Seamless integration of the system within the existing electrical distribution network with minimum downtime
- Cloud based systems obviates the need for costly servers at site
- Enables reporting and compliance as per norms such as for ISO:50001, ECBE, etc.
- Acts as a strong measurement and verification tool
- Effectively captures areas of possible ene… additional cost savings, thereb… investment in long term

Helps enable tracking energy deviations and enable corrective actions in real time!!!....

Average EPI 88 kWh/sq. m





Performance Protocols

ENERGY MANAGEMENT PROTOCOL FOR YOJANA BHAWAN			
Location	Application	Observations	Remarks
Ground Floor reception	Lighting at waiting room	High lux levels	Natural light available, switch off artificial lights during day time near to windows
All floors	Lift Lobby lighting	All lights on through-out the day	Switch on all lights during peak times (office in and out times) and during other times of the day use alternate lights. Switch off lights near to the window frame from where artificial light is available
All floors	Staircase lighting	All lights on through-out the day	Lights near to window frame could be kept off during the day to utilize natural light
All floors	Washroom lighting	All lights on through-out the day	Use of occupancy sensors is recommended to avoid redundant ON time of lights
Meeting rooms	Portable air-conditioners	ACs are found to be running generously	Use optimal number of AC units as per occupancy and AC could be switched on 10 to 15 minutes prior to meetings and switched off immediately after the meeting
All rooms	Portable air-conditioners	AC temperature optimization	ACs should be used with set point at 24 to 25 degree Celsius
All rooms	Electronics	Many items left on	All printers/Xerox machines/chargers, to be kept off during holidays
Use of heater loads such as tea maker, food warmer, etc. should be avoided			
All AC to be switched off during public holidays mandatorily and in case of need, prior intimation given to admin			
Efforts should also be made to keep all lights especially in corridor and washrooms off during public holidays accept for some exigency requirements on 1st and 2nd floor			
Staff should switch off lights/fans/ACs whenever going out of their rooms/cabins			
Staff should be incentivized for active participation in cultivating energy efficiency across the building			
For lifting water to overhead tank, new energy efficient booster pump use should be maximized			
Washrooms exhaust fan usage should be optimized to avoid loss of cool air			
Keep doors/windows of air-conditioned spaces closed to avoid heat gain. Chaulk and weather strip doors/ windows			
Do not allow people to use water from fire lines for cleaning/service purpose			
Use low flow urinals. Check water leakages from pipes, taps, urinals, faucets, etc., and reduce			
Maximize natural lighting into the buildings and use glass insulation film to cut heat gain			

Let us paint...
Make India
Green!!